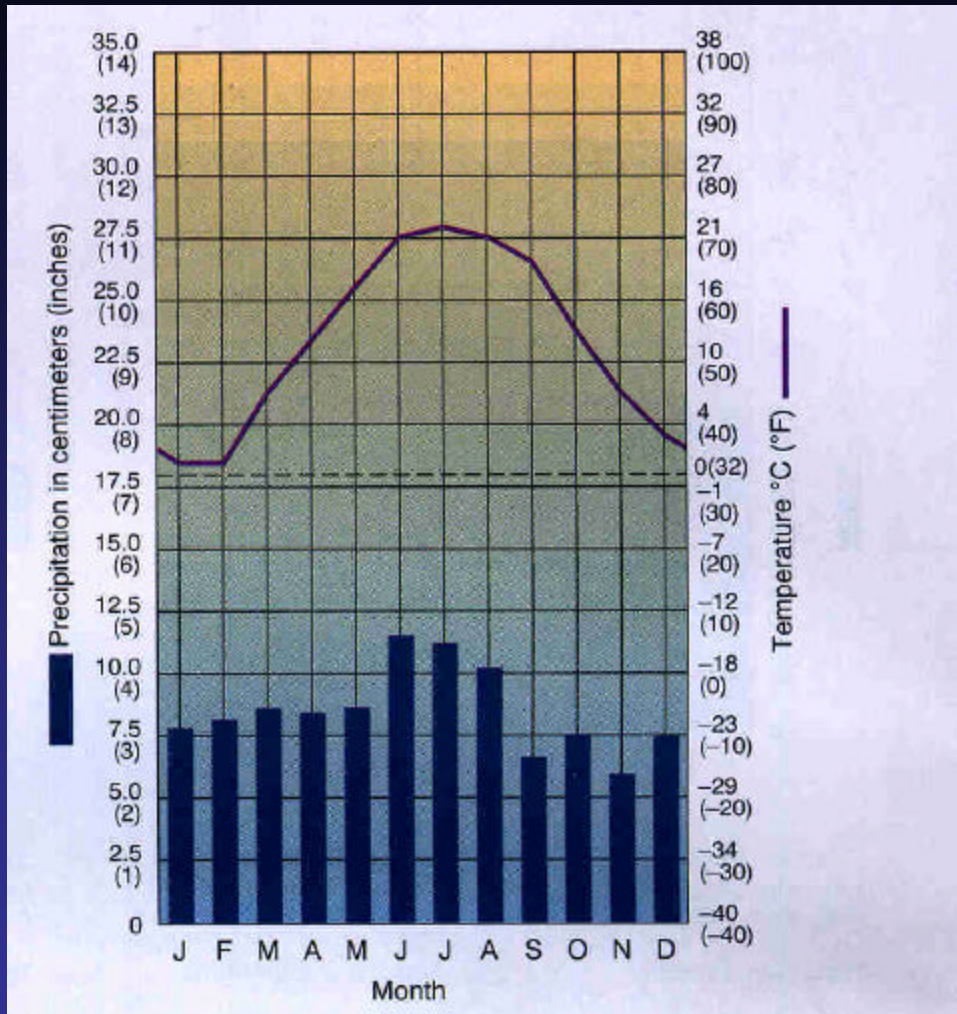
Weather = *short-term day-to-day condition of the atmosphere*

Climate = *long-term average of weather conditions and extremes in a region*

(b)

Climate as average monthly conditions

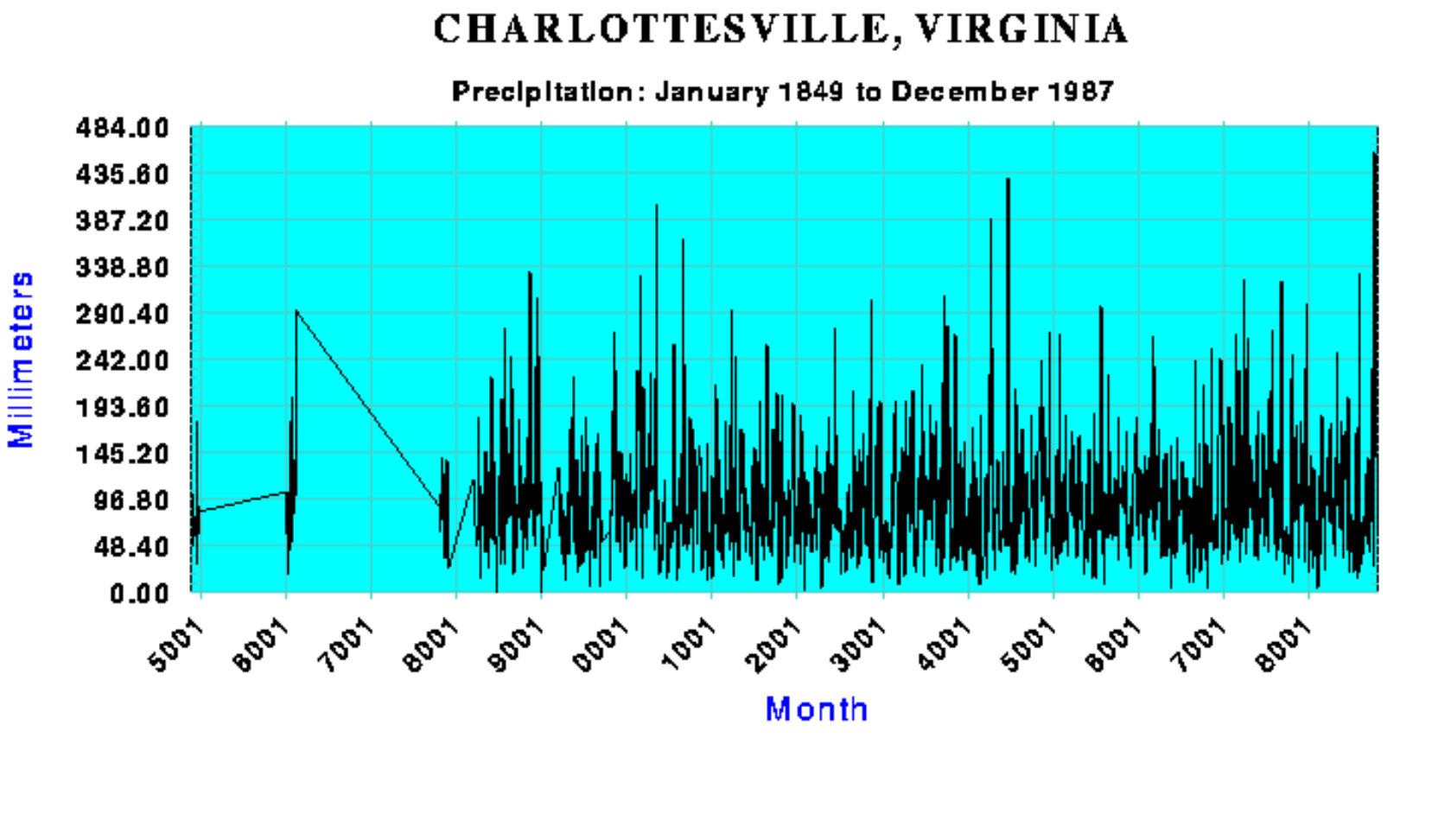


Station: Bluefield, West Virginia **Cfb**
Lat/long: 37°16′ N 81°13′ W
Avg. Ann. Temp.:
12°C (53.6°F)
Total Ann. Precip.:
101.9 cm (40.1 in.)

Elevation: 780 m (2559 ft)
Population: 16,000
Ann. Temp. Range:
21 C° (37.8 F°)

(a)

Climate as long-term trends…



CLIMATE: Spatial Scales

Microclimate = *climate of a very small area at the ground or canopy surface*

(ex. mt. ridge, treetop, riverbank)

Mesoclimate = *climate of a small region of the Earth's surface*

(ex. C'ville or Central VA)

Macroclimate = *climate of a large region*

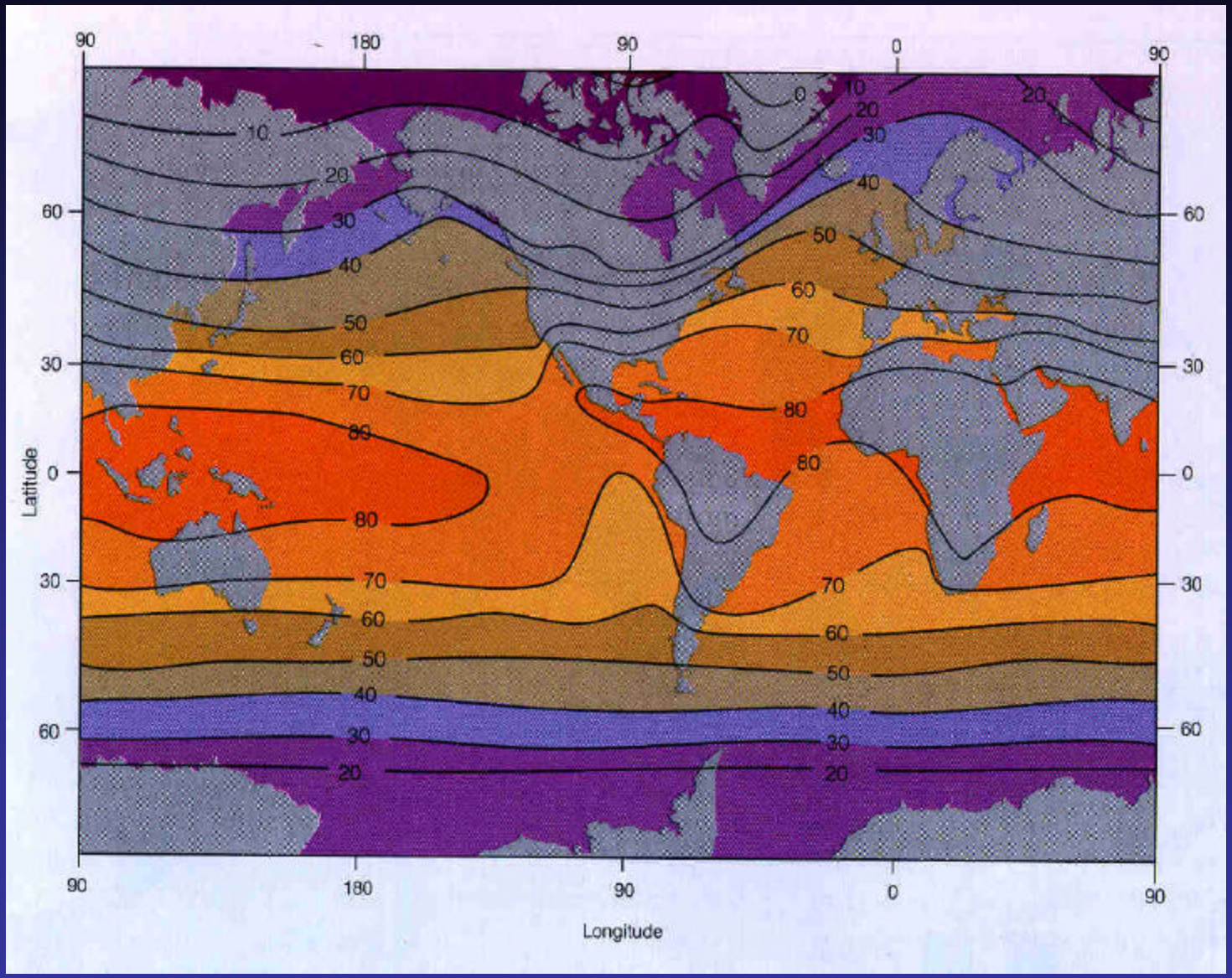
(state or country – ex. Eastern U.S.)

Global climate = *Earth's climate*

Climate Controls

1. intensity of solar radiation and its variation
2. distribution of land and water
3. ocean currents
4. prevailing winds
5. positions of high- and low-pressure
6. mountain barriers
7. altitude

GLOBAL TEMPERATURE



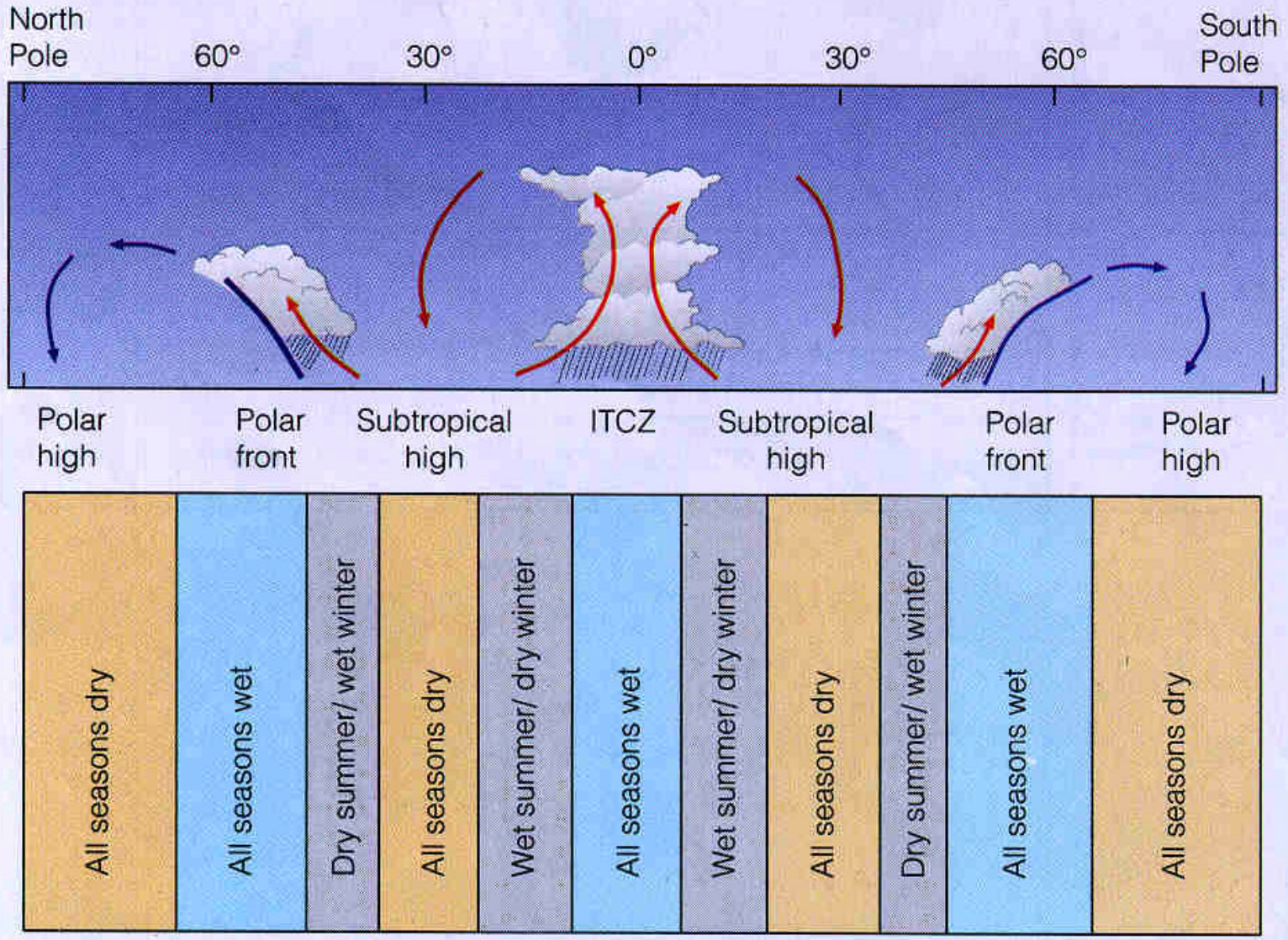
Hottest Places on Earth

Death Valley	July 10, 1913	57°C (134°F)
Yuma, AZ	high ave July temp in 1917	42°C (108°F)
Alton, Kansas	1936	49°C (121°F)
Fayetteville, NC	1983	43°C (110°F)
Dallol, Ethiopia	1960-1966 ave high temp	>38°C(100°F)
Dallol, Ethiopia	Sept. 13 1922	58°C (136°F)

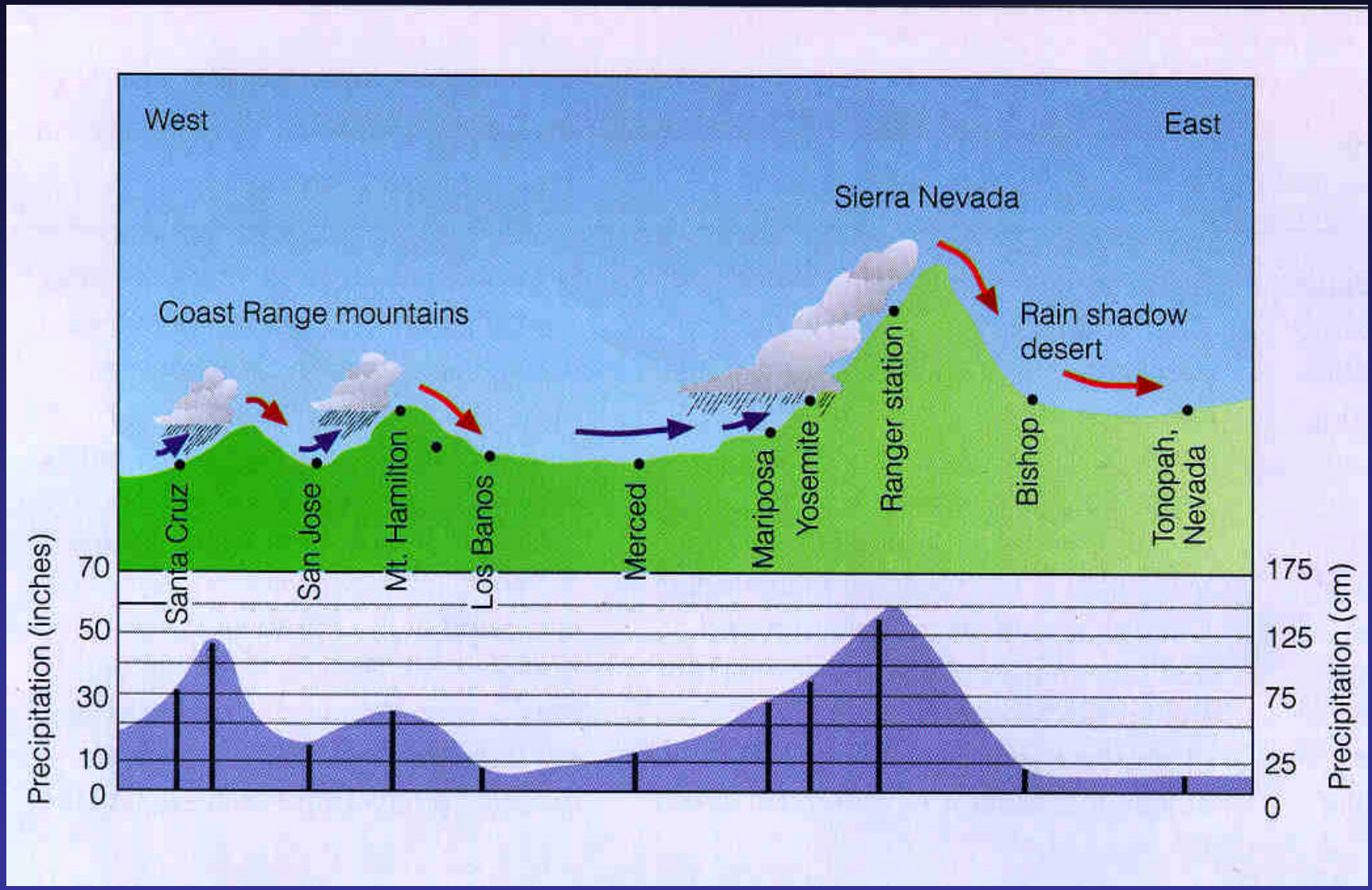
Coldest Places on Earth

International Falls, MN	avg. Jan temp	-16°C (3°F)
Minneapolis, MN	1911-1912	186 consecutive day < -18°C (0°F)
Rogers Pass, MT	1954	-54°C (-70°F)
Prospect Creek, AK	Jan 23, 1971	-62°C (-80°F)
S. Pole	June 23, 1983	-83°C (-117°F)
Vostok, Antarctica	July 21, 1983	-89°C (-129°F)

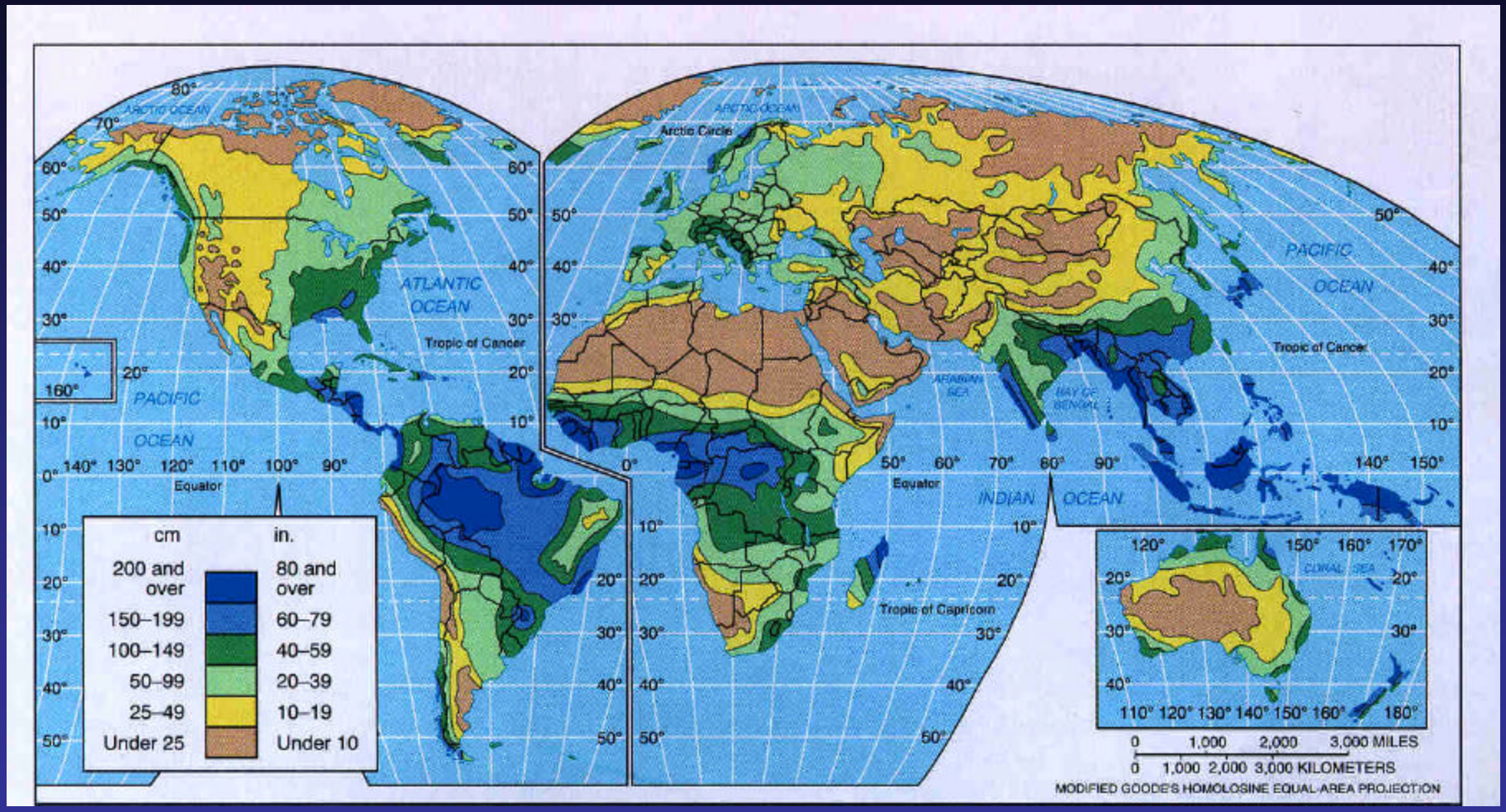
GLOBAL PRECIPITATION



Rain shadows and Cloud forests



Distribution of Global Precipitation



- note: change in rainfall pattern along w. coast of S. America. Why?
- Why is central and e U.S. wetter but central Asia desert and steppe?

Extremes of Precipitation

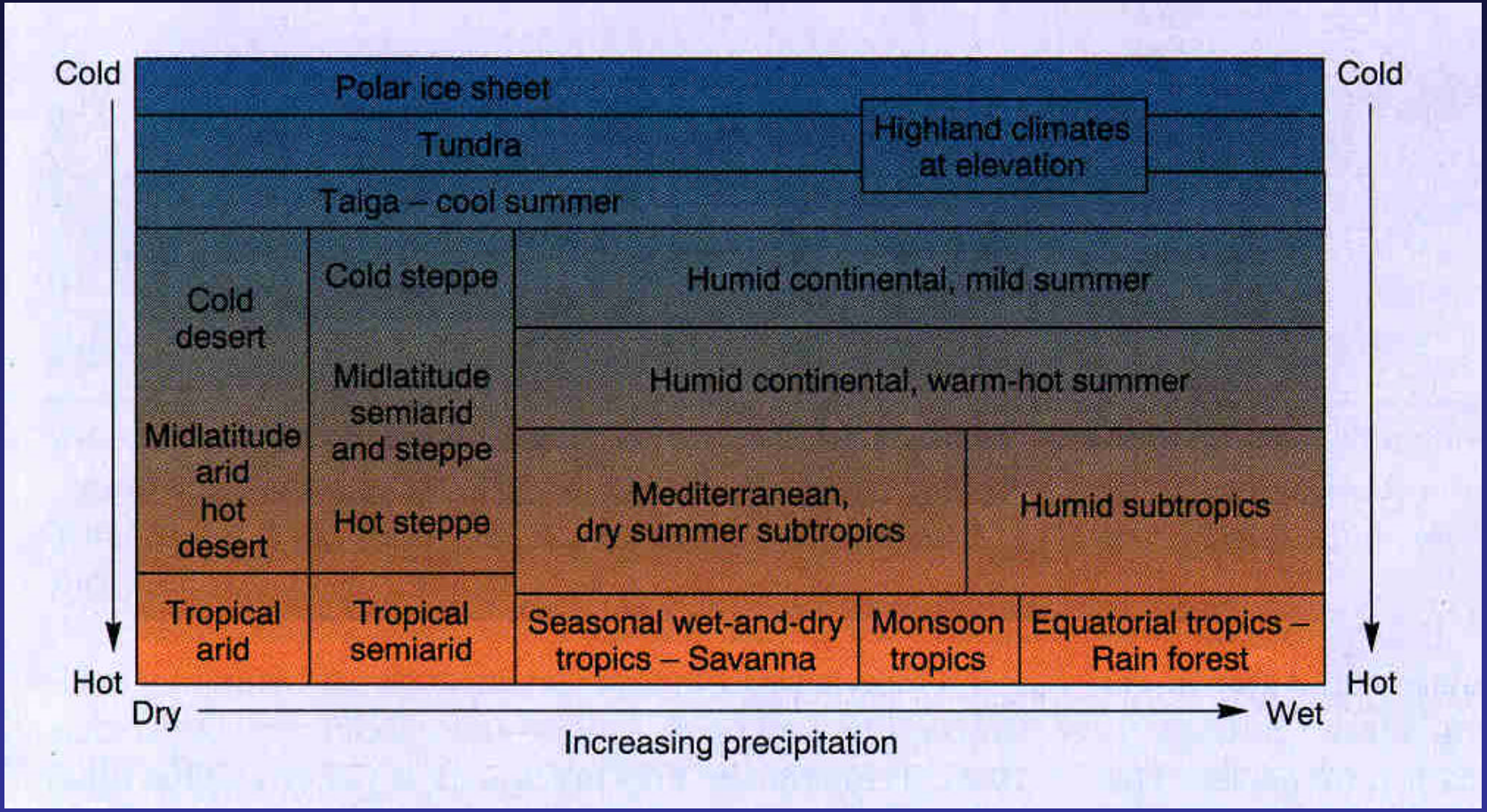
World's greatest ann. average	460 inches	Mt. Waialeale, Hawaii
Greatest 1-month total	366 inches	Cherrapunji, India, July, 1861
Greatest 12-hour total	53 inches	Belouve, La Reunion Island, February 28, 1964
Greatest 24-hr total in U.S.A.	43 inches	Alvin, TX, July 25, 1979
Greatest 1-min total in U.S.A.	1.2 inches	Unionville, MD, July 4, 1956
Lowest annual average in N. Hem.	1.2 inches	Bataques, Mexico
Lowest annual ave. in the world	0.03 inches	Arica, Chile
Greatest annual snowfall in U.S.A.	1122 inches	Paradise Ranger Station, Mt. Rainier, WA, 1971-1972
Greatest snowfall in 1 month	390 inches	Tamarack, CA, Jan 1911
Greatest snowfall in 24 hours	76 inches	Silverlake, Boulder, CO April 14-15, 1921

Climate Classification

Ancient Greek System

1. torrid zone
2. temperate zone
3. polar or frigid zone

Relationship between Temperature and Precipitation



Köppen System = 5 major climatic types, based on temperature AND precipitation

A: tropical climates

B: dry climates

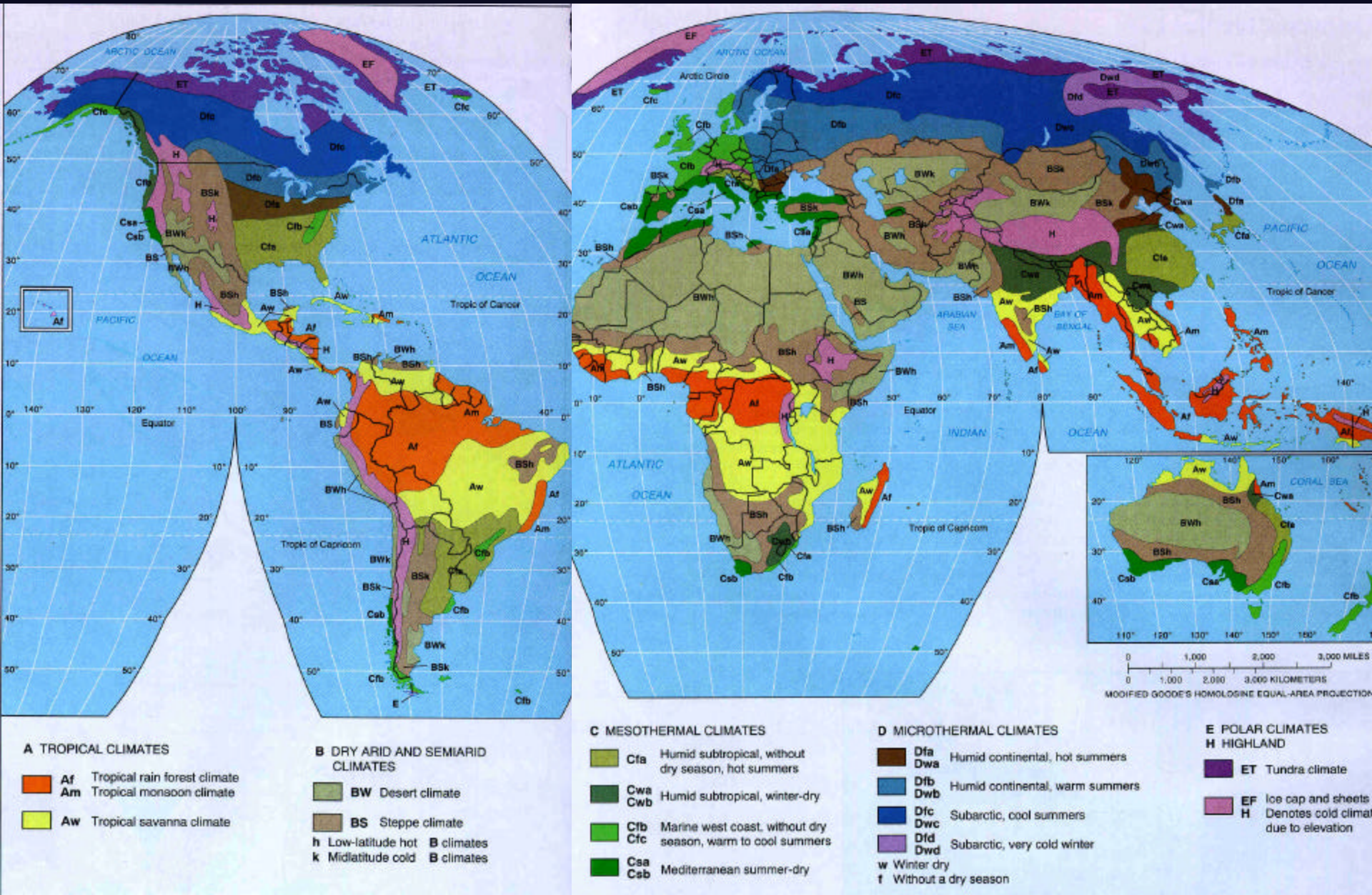
C: mesothermal (Moist Mid-Latitude with mild winters)

D: microthermal (Moist Mid-Latitude with severe winters)

E: polar climates

H: highland climates

Distribution of Climate



Biomes = ***major set of species distributed over a large geographic region - considered to be the largest definable biological/ecological community***

Climograph

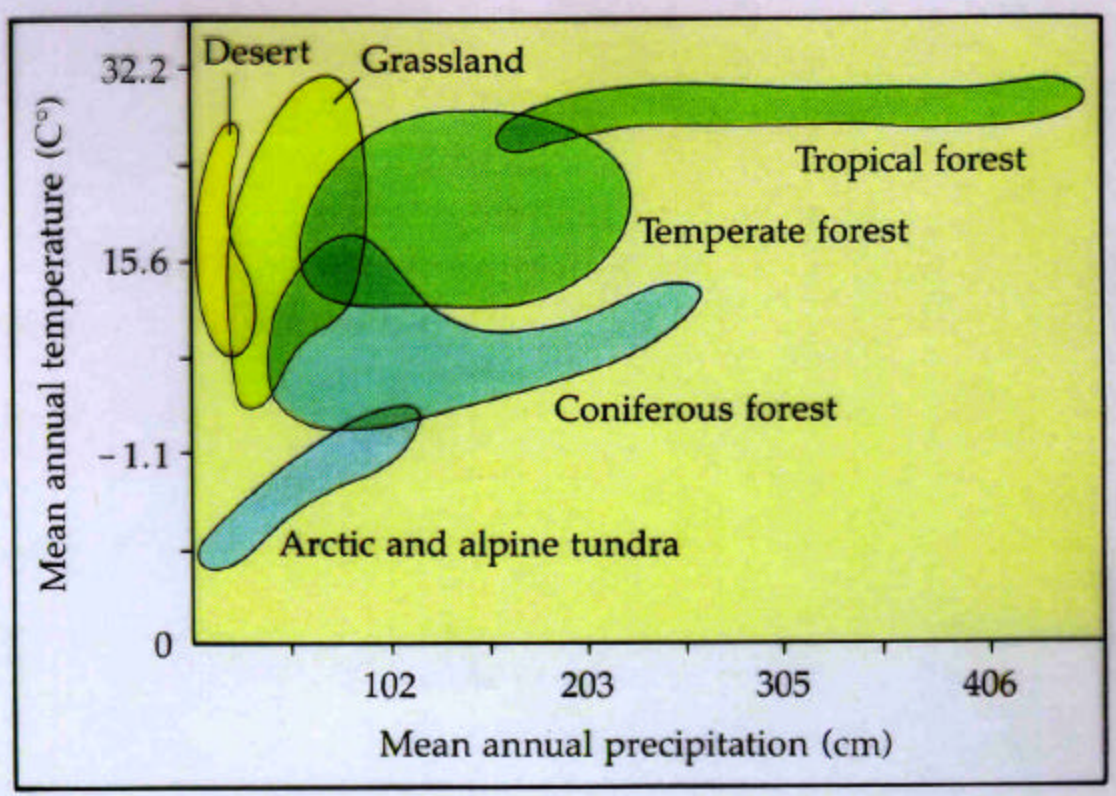
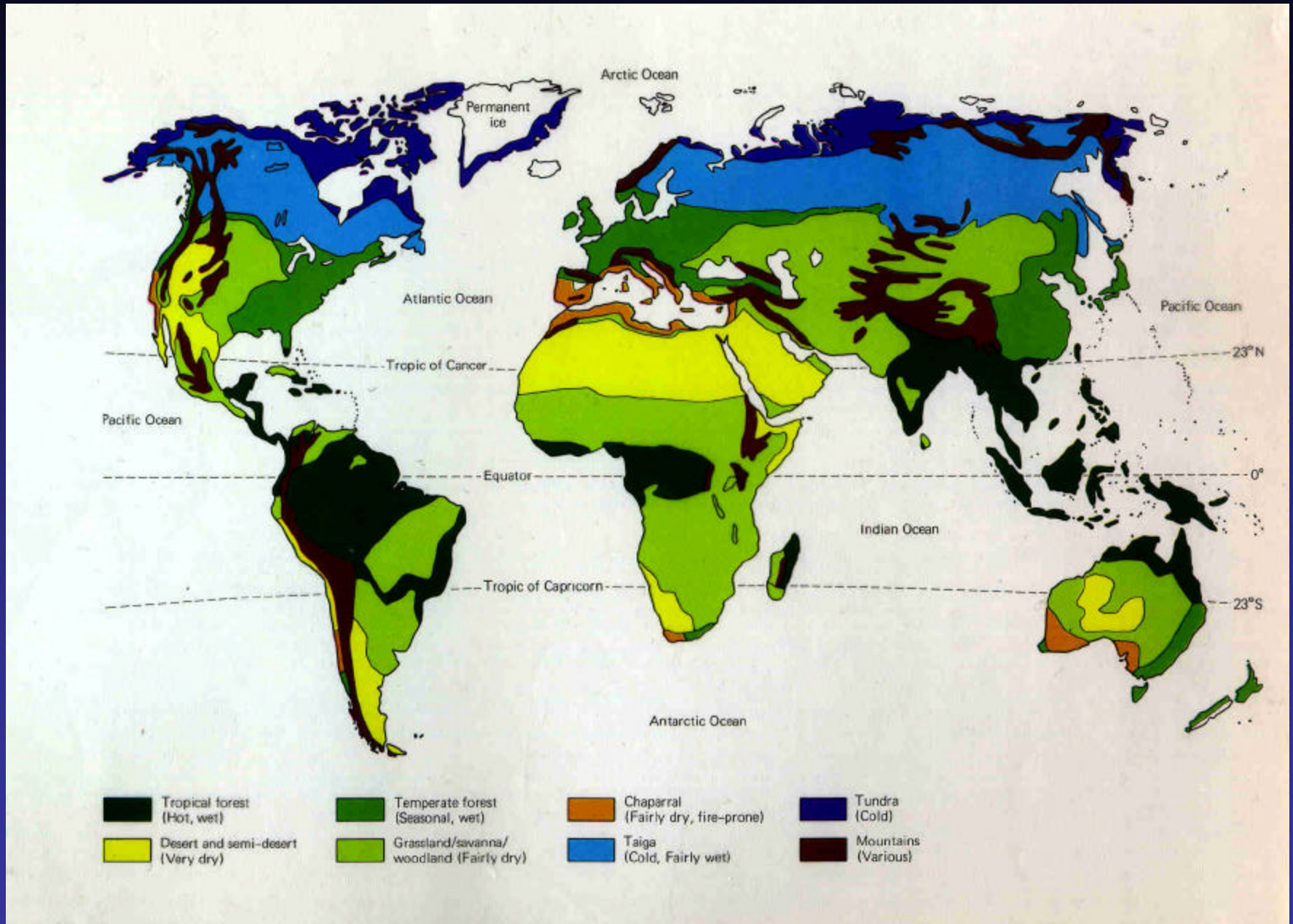


Figure 46.22
A climograph for some major North American biomes. The areas plotted here encompass the annual mean temperatures and precipitation occurring in some major North American biomes. The climograph provides only circumstantial evidence, however, that these factors are important in explaining the distribution of the biomes. The areas of overlap, for example, show that these variables alone are not sufficient to explain the observed distribution.

Distribution of Biomes



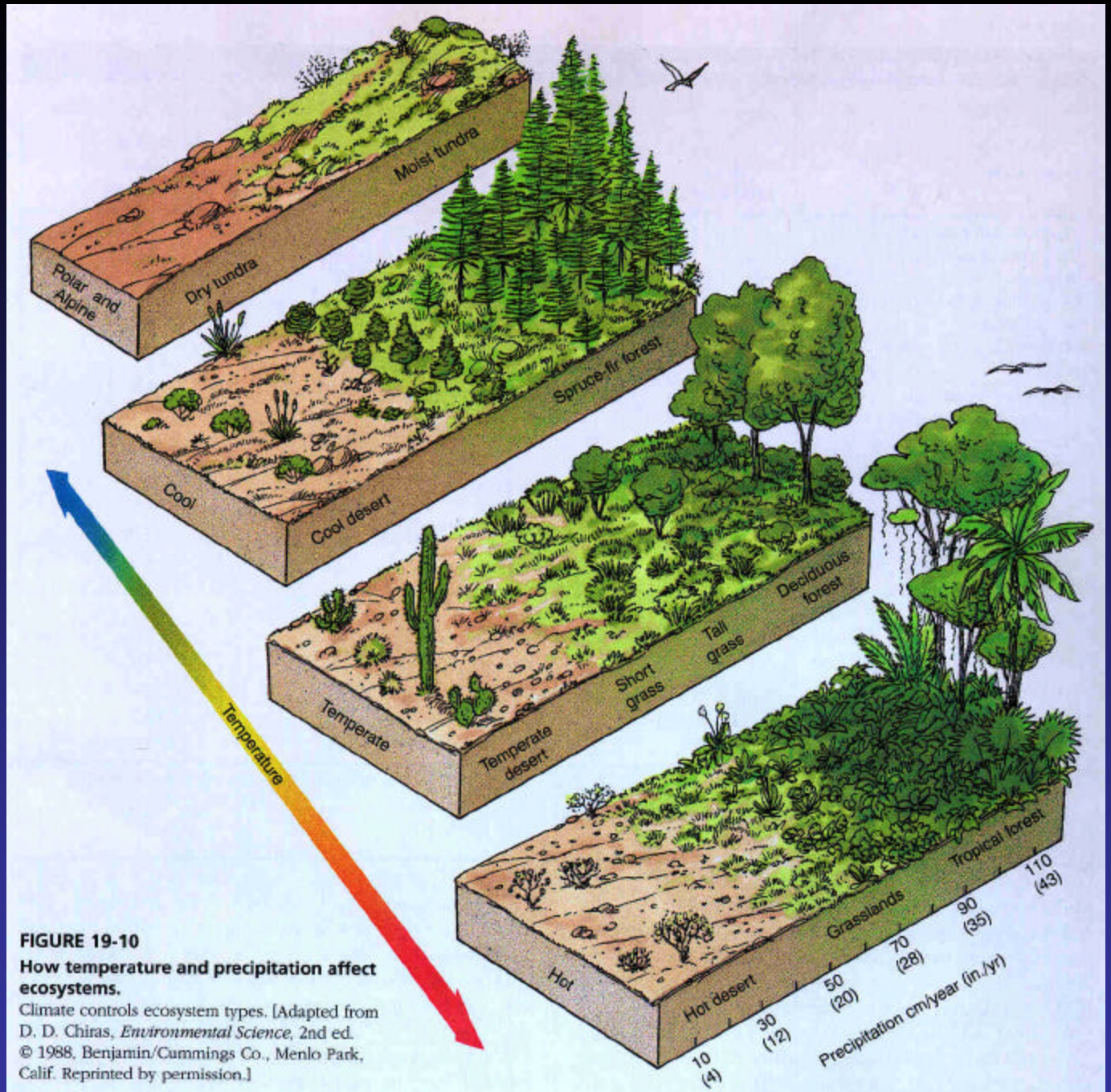
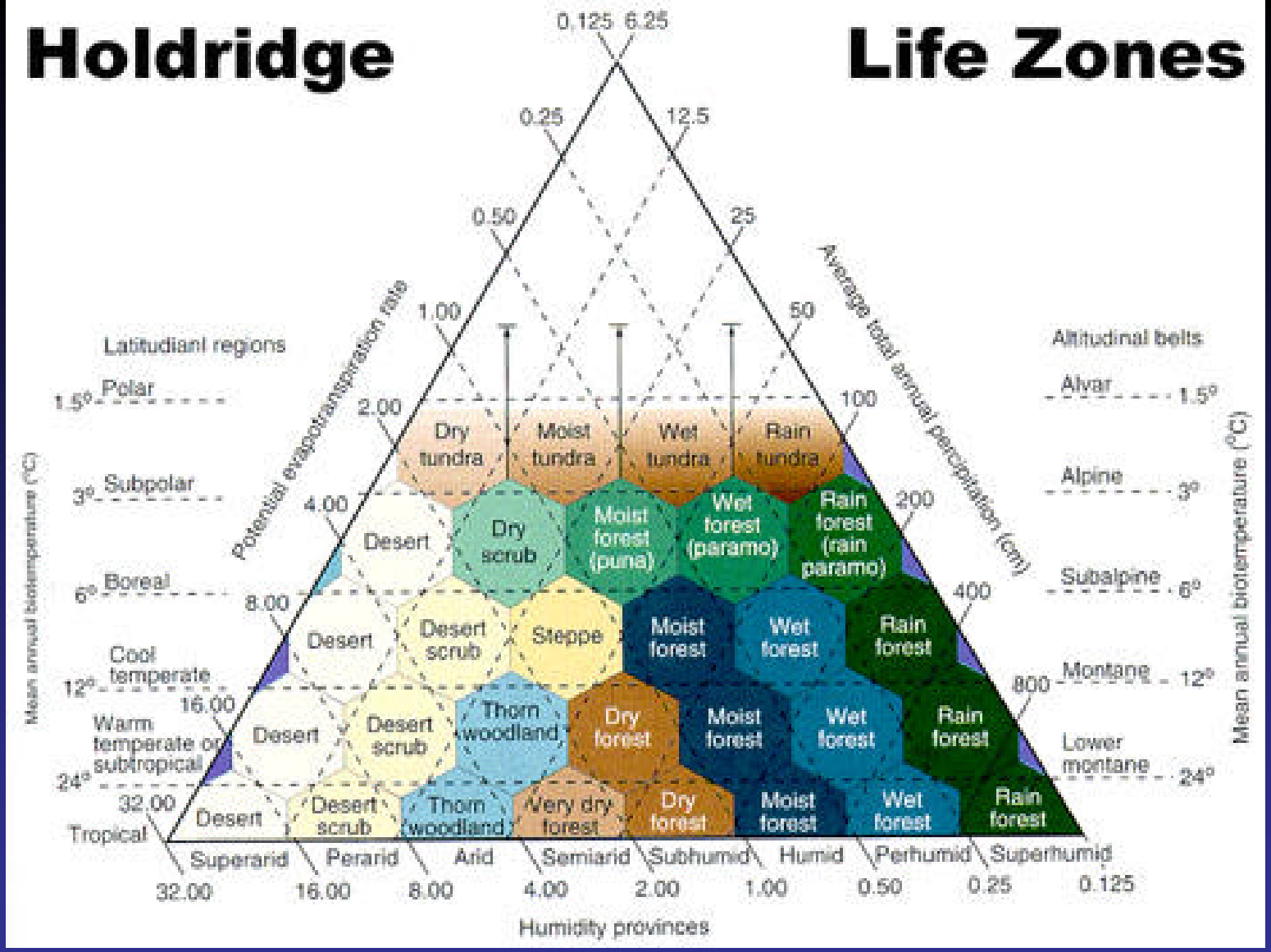


FIGURE 19-10

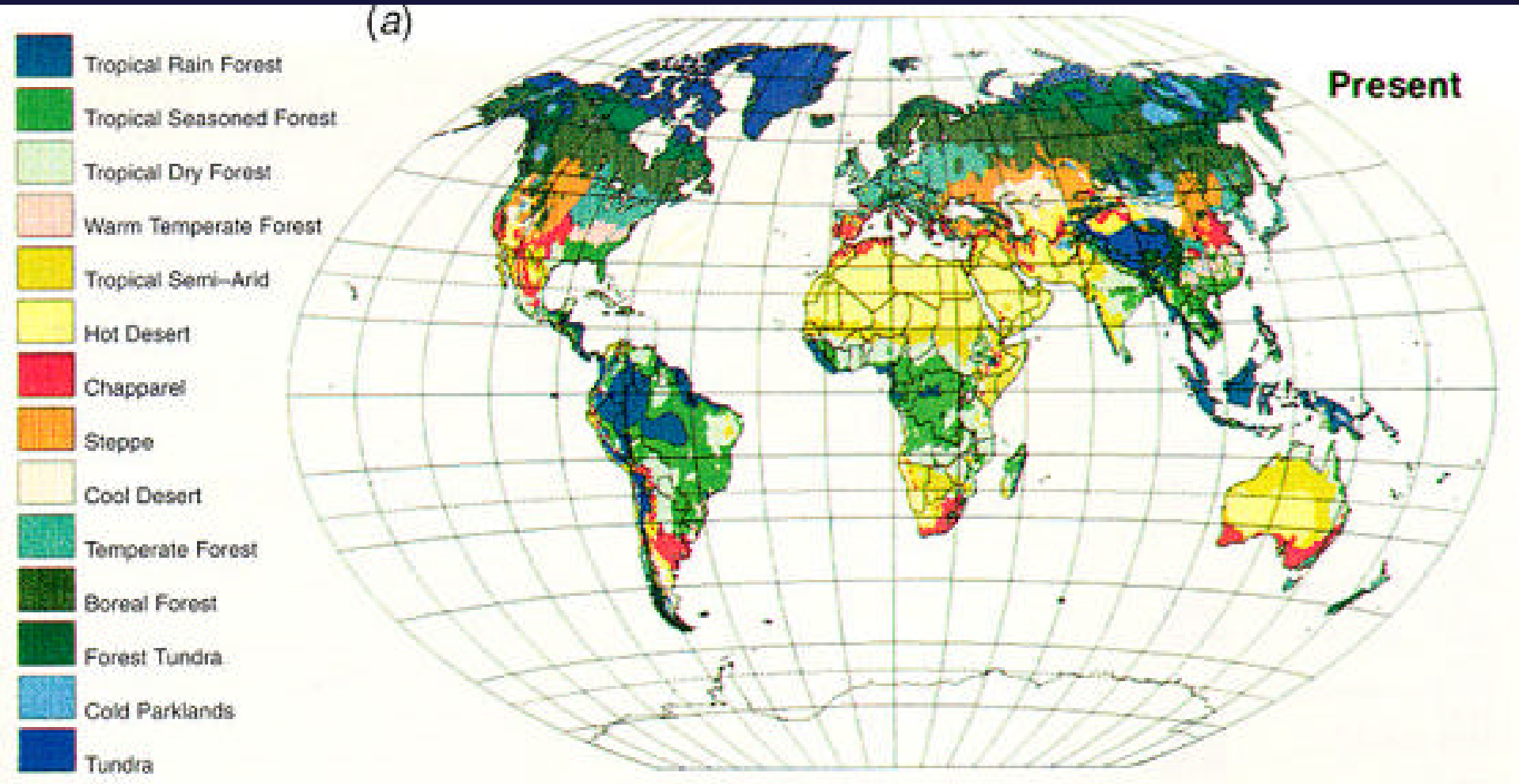
How temperature and precipitation affect ecosystems.

Climate controls ecosystem types. [Adapted from D. D. Chiras, *Environmental Science*, 2nd ed. © 1988, Benjamin/Cummings Co., Menlo Park, Calif. Reprinted by permission.]



Based on * mean annual biotemperature (rounds all freezing <0°C temps to 0)
*** total annual precipitation**
*** ratio of PET : annual precipitation**

Global vegetation based on Holdridge Life Zones



Distribution of Urban and Agricultural "Biomes"

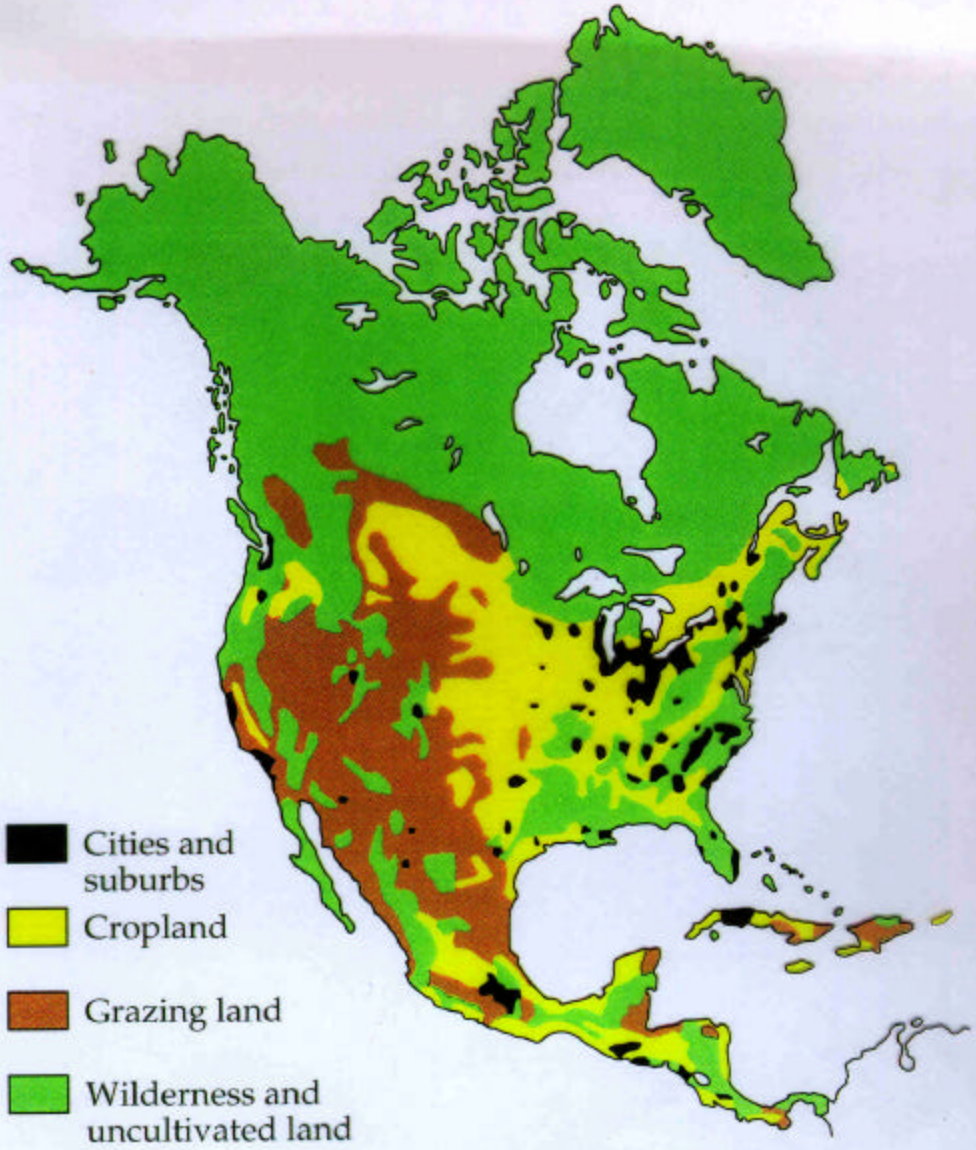
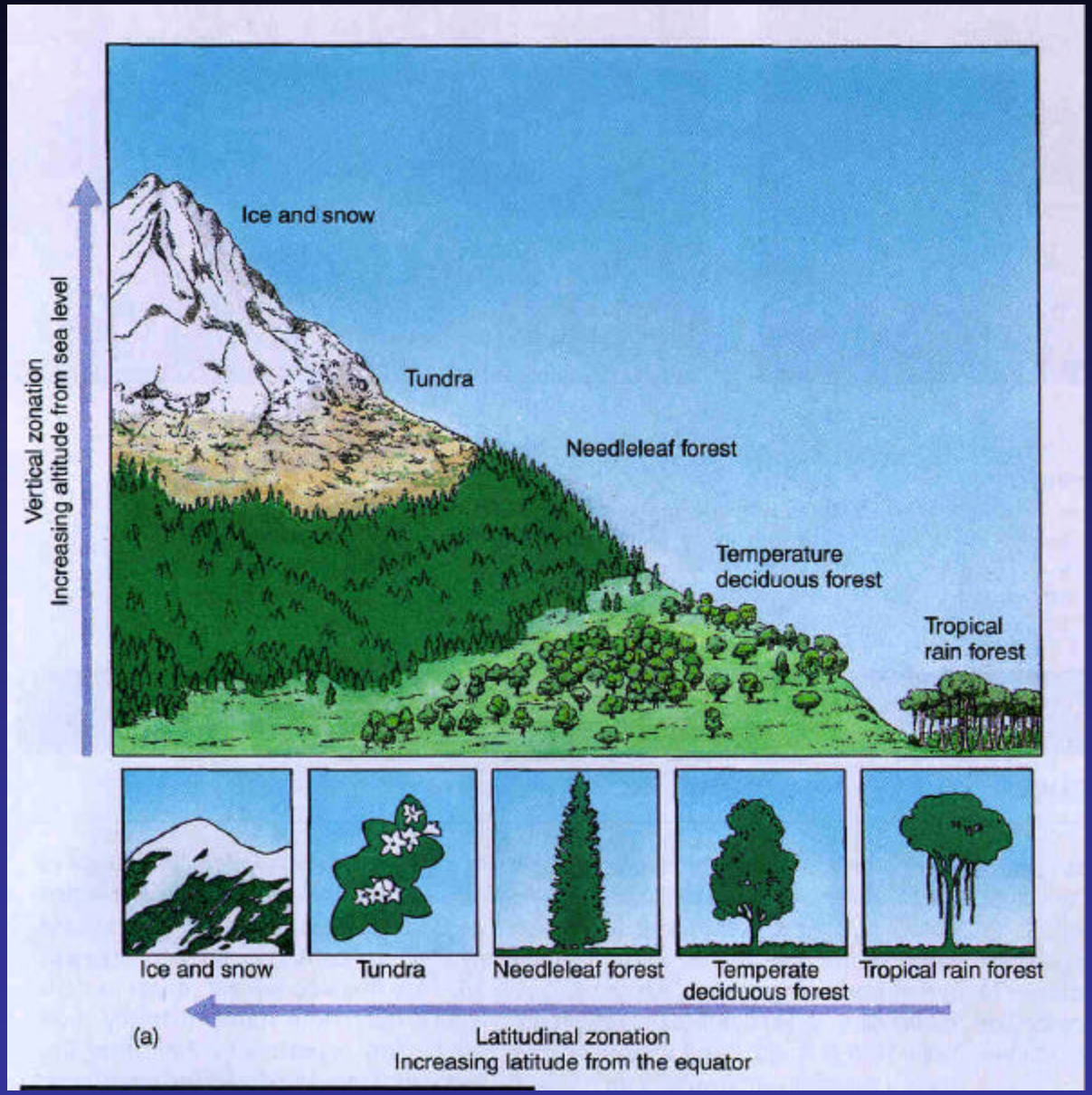


Figure 46.4
Urban and agricultural biomes. Many regions on Earth have been disturbed by intense human activity. In urban and agricultural biomes, natural communities have been replaced by housing, industry, cropland, and grazing range. Relatively few undisturbed habitats remain in most regions on the planet.

H: Highland climates

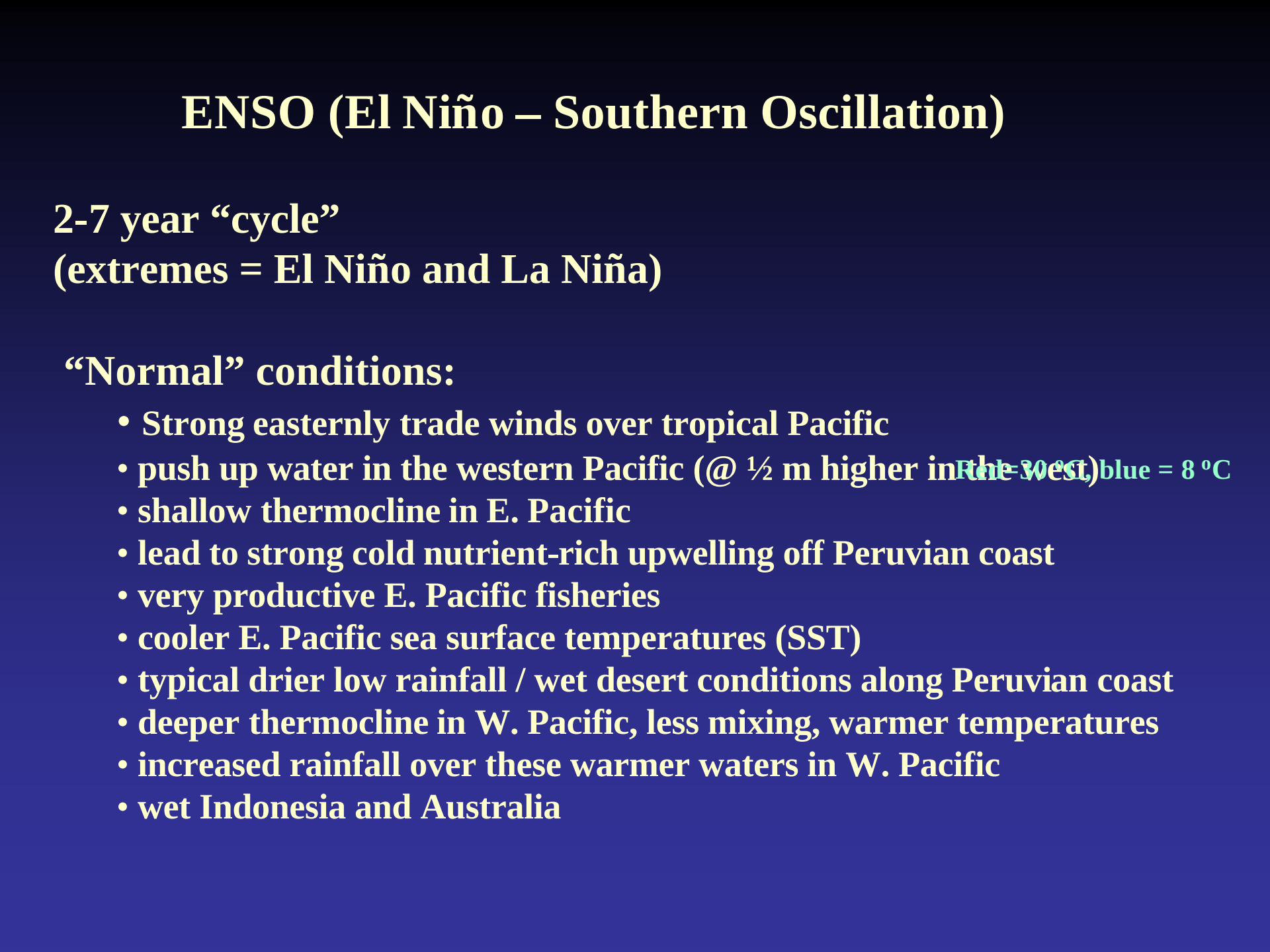


ENSO (El Niño – Southern Oscillation)

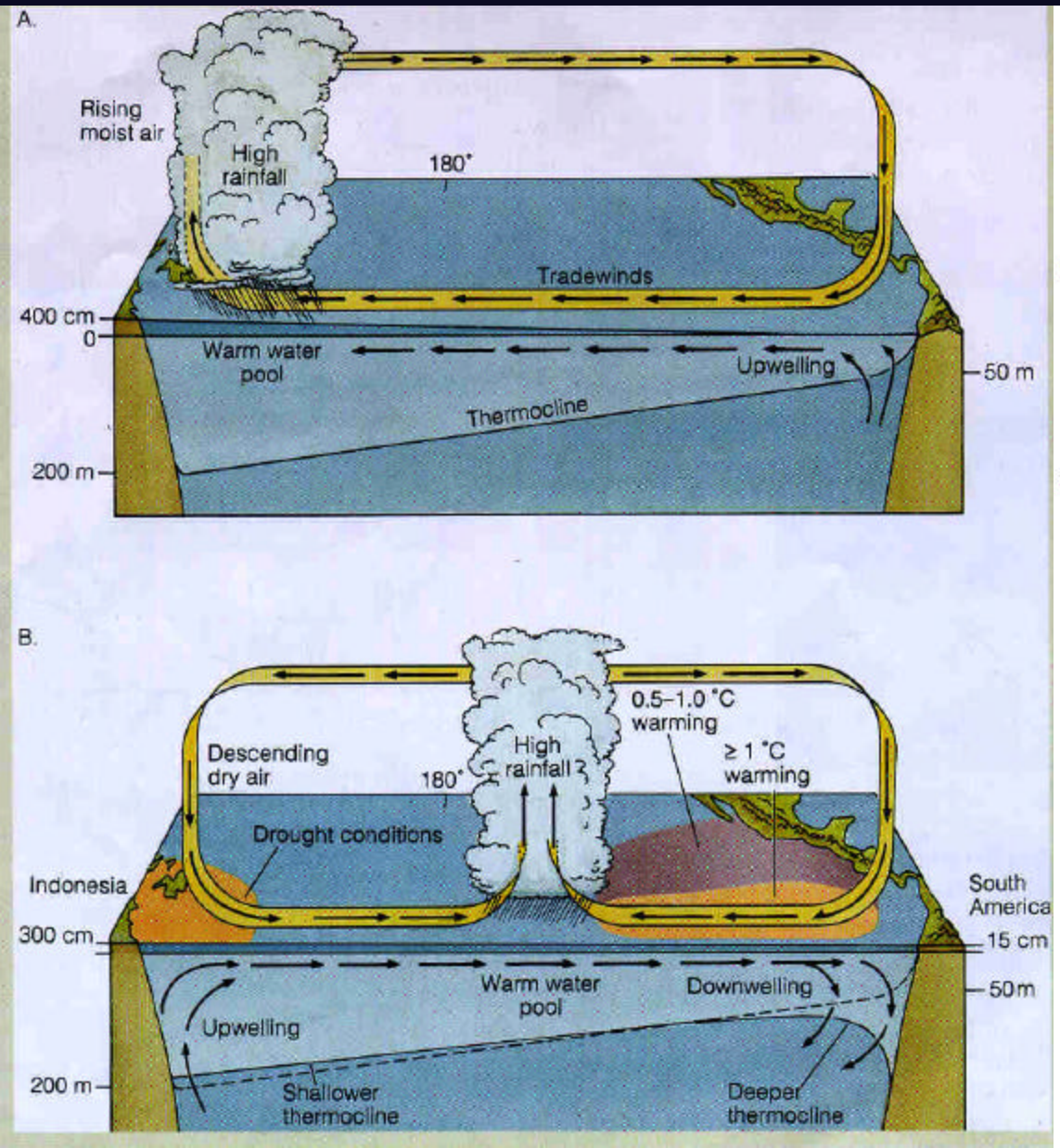
2-7 year “cycle”
(extremes = El Niño and La Niña)

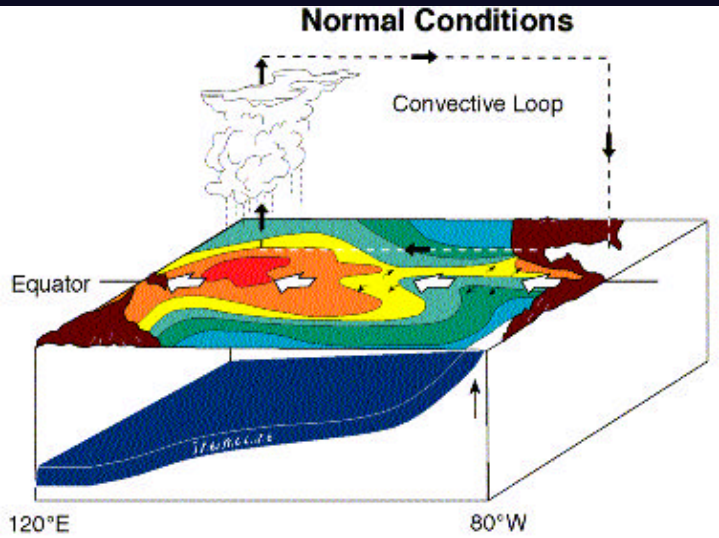
“Normal” conditions:

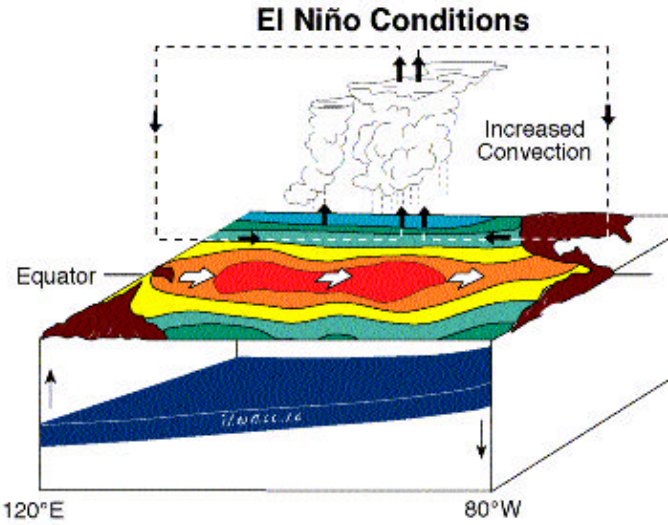
- **Strong easternly trade winds over tropical Pacific**
- **push up water in the western Pacific (@ ½ m higher in the west)**
- **shallow thermocline in E. Pacific**
- **lead to strong cold nutrient-rich upwelling off Peruvian coast**
- **very productive E. Pacific fisheries**
- **cooler E. Pacific sea surface temperatures (SST)**
- **typical drier low rainfall / wet desert conditions along Peruvian coast**
- **deeper thermocline in W. Pacific, less mixing, warmer temperatures**
- **increased rainfall over these warmer waters in W. Pacific**
- **wet Indonesia and Australia**



ENSO







NOAA/PMEL/TAO

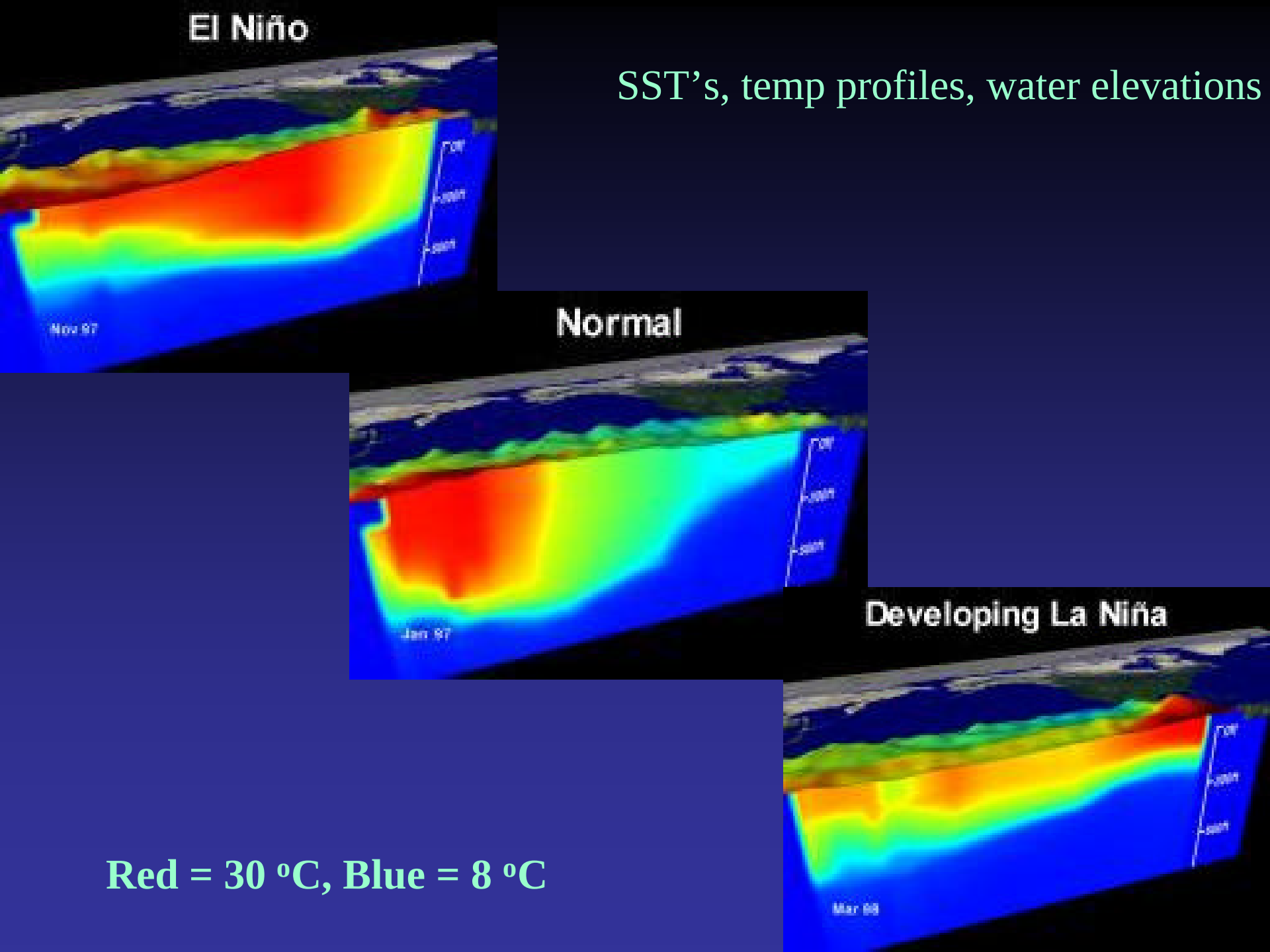
ENSO (El Niño - Southern Oscillation)

El Niño conditions:

- Easternly trade winds subside / weaken.
- water elevation gradient lessens and disappears
- thermocline deepens in E. Pacific, shallows in W. Pacific
- lessens or cuts off upwelling (b/c of stronger stratification)
- very UNproductive E. Pacific fisheries
- warmer E. Pacific SST, cooler W. Pacific SST
- reverses rainfall patterns along Peruvian coast (wet deserts, dry cropland)
- decreased rainfall in W. Pacific
- dry Indonesia and Australia, lots of wildfires

La Niña conditions:

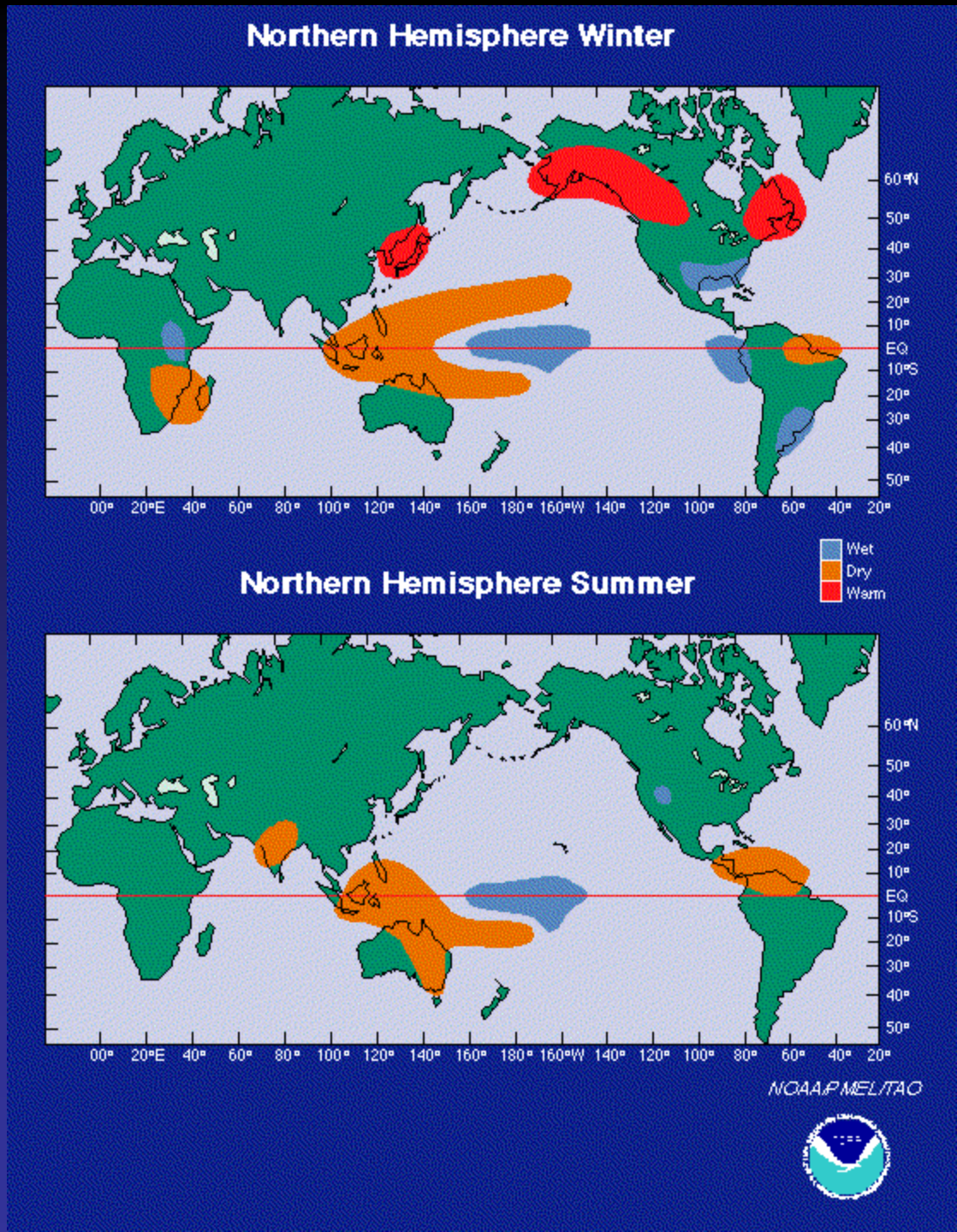
- same as “normal” but even stronger



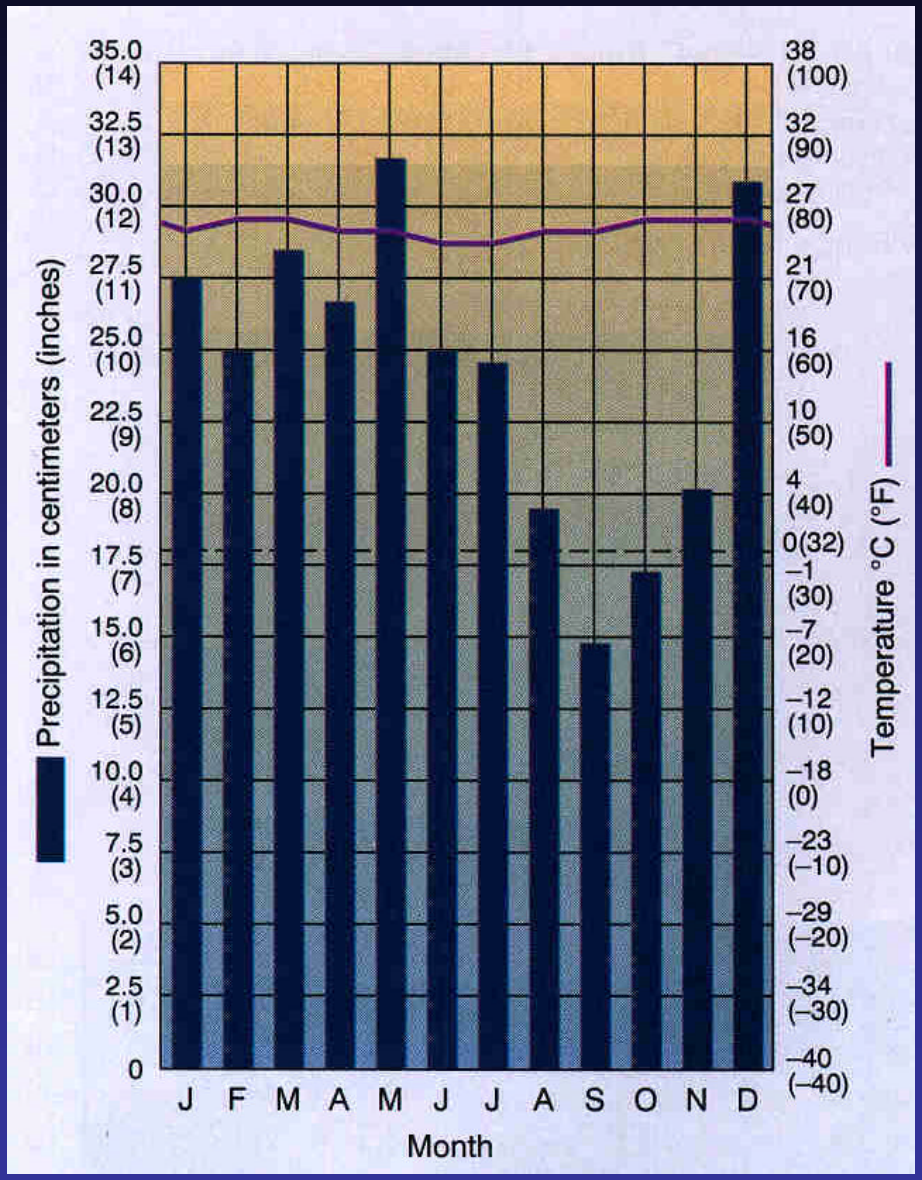
SST's, temp profiles, water elevations

Red = 30 ^{o}C, Blue = 8 ^{o}C

Global short-term climate shifts due to El Niño

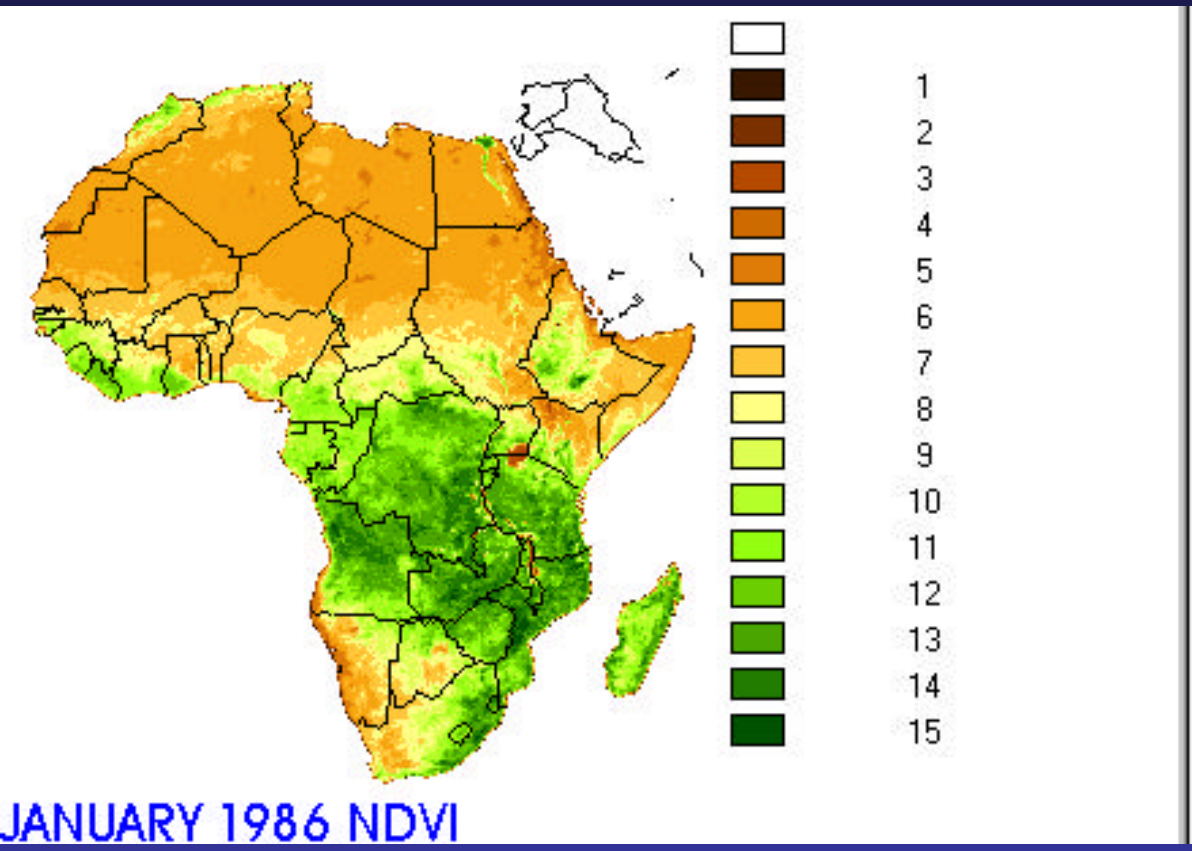


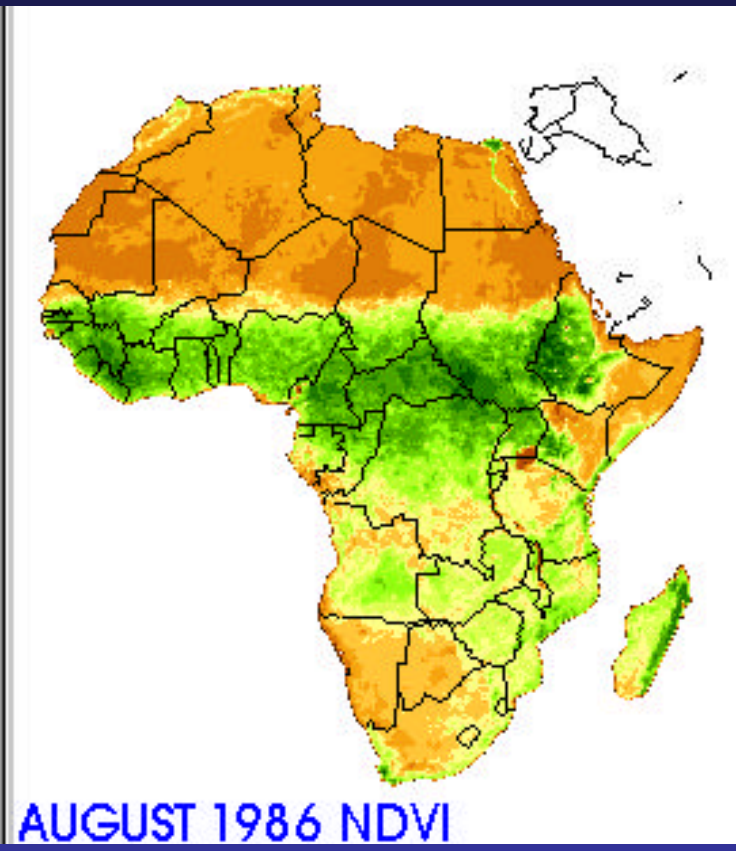
Tropical Rain Forest (Af)



Station: Uaupés, Brazil **Af**
Lat/long: 0°08' S 67°05' W
Avg. Ann. Temp.: 25°C (77°F)
Total Ann. Precip.: 291.7 cm (114.8 in.)
Elevation: 86 m (282.2 ft)
Population: 7500
Ann. Temp. Range: 2 C° (3.6 F°)
Ann. Hr of Sunshine: 2018

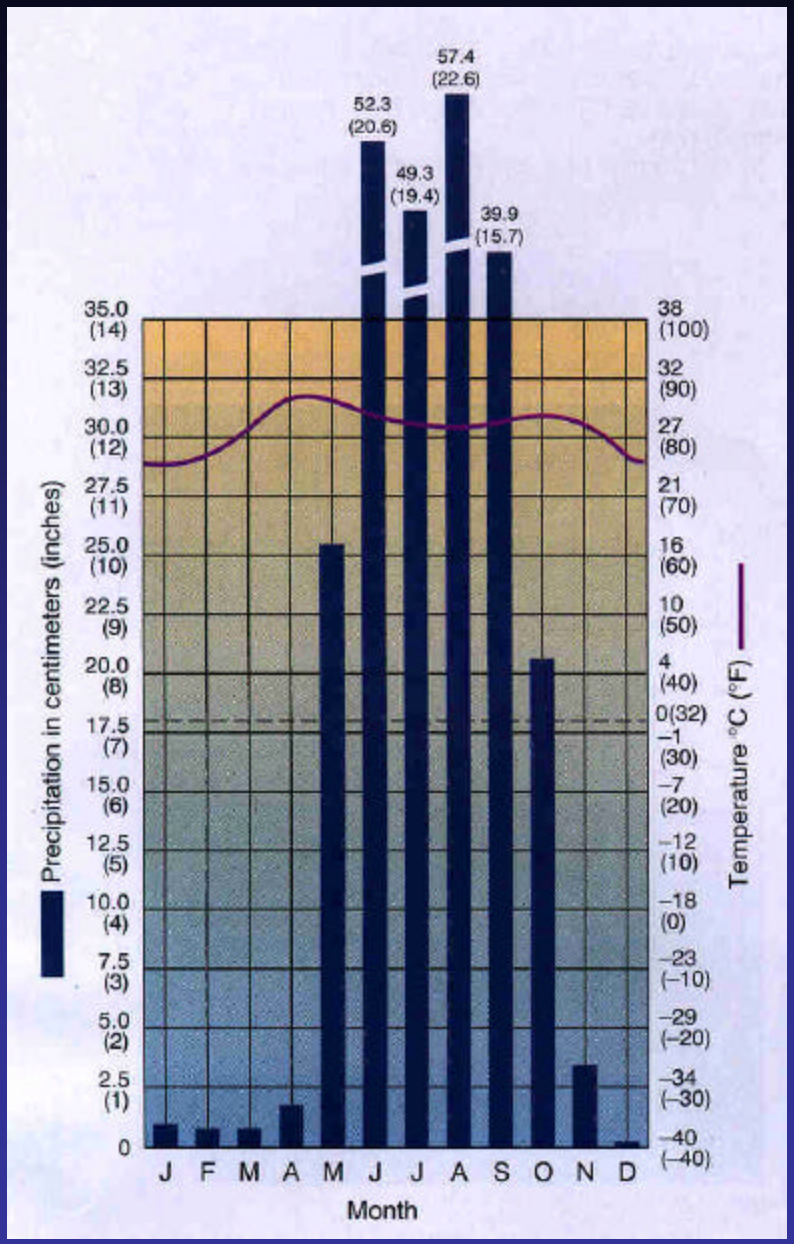
Seasonal migration of the ITCZ





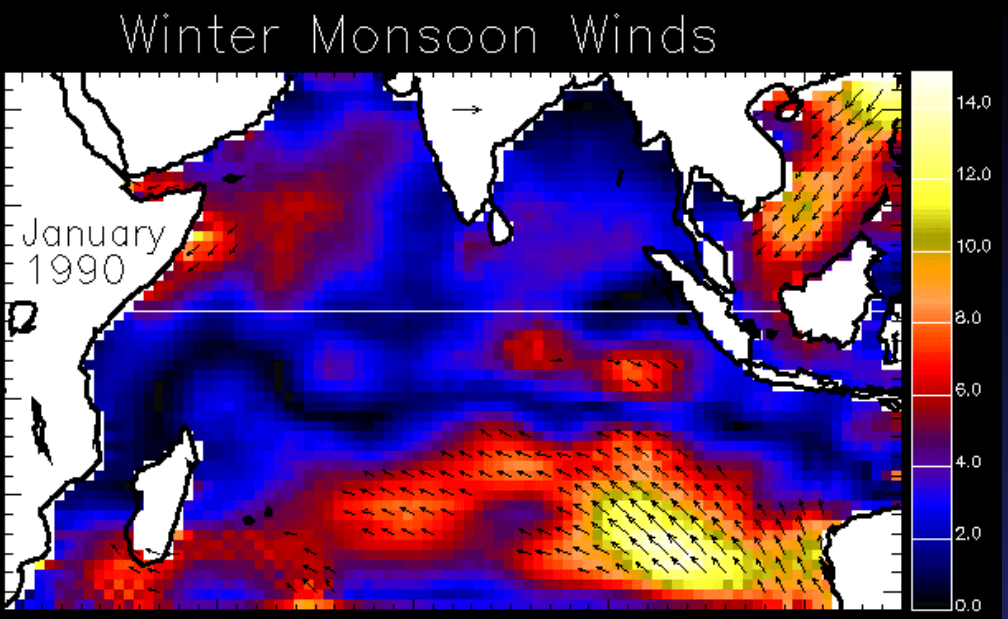
* Sahel lands N & S bordering deserts

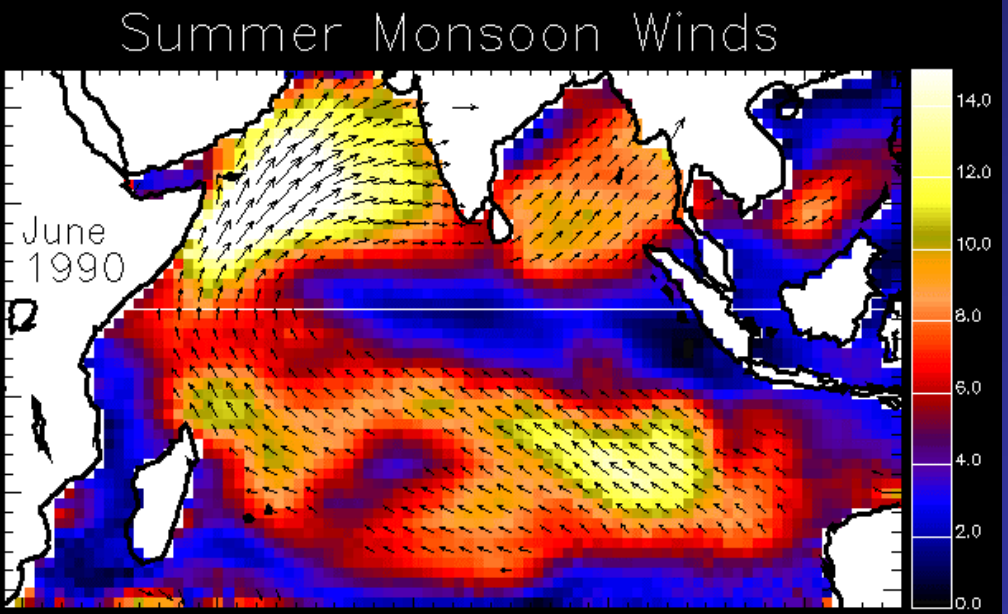
Tropical Monsoon (Am)



Station: Yangon, Myanmar* **Am**
Lat/long: 16°47' N 96°10' E
Avg. Ann. Temp.: 27.3°C (81.1°F)
Total Ann. Precip.: 252.7 cm (99.5 in.)
Elevation: 23 m (76 ft)
Population: 2,458,700
Ann. Temp. Range: 5.5 C° (9.9 F°)

*(Formerly Rangoon, Burma)





Monsoons

Causes:

- **Differential heating between the land and oceans**
- **Coriolis force**
- **Warm ocean waters**

Strongest monsoons are in India and SE asia.

- **Very warm Indian Ocean.**
- **Tropical/subtropical sun.**
- **High himalayas which split jet stream in winter.**

Microclimate Variation:

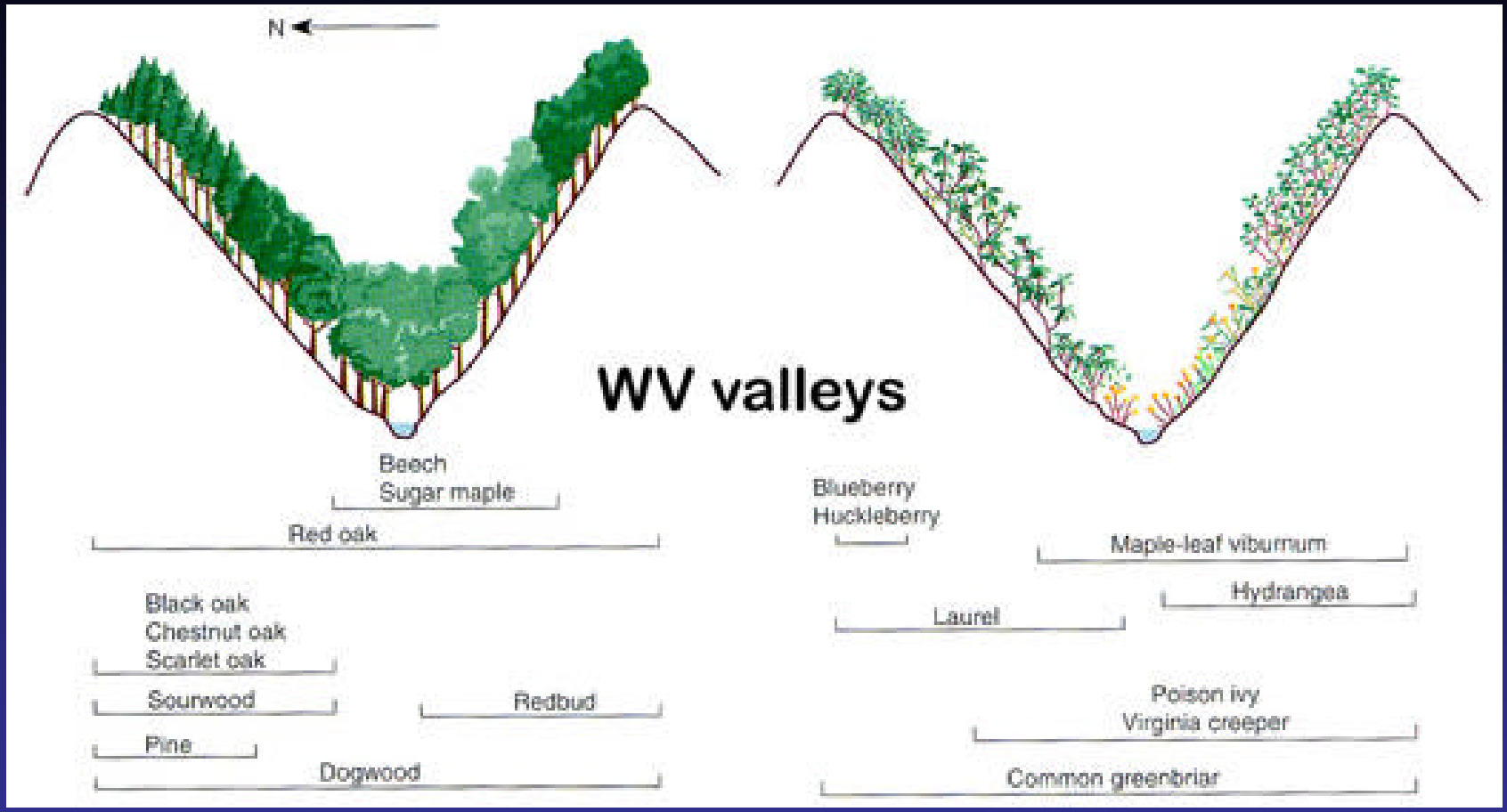
describing local environmental conditions…

Xeric* : *extremely dry.

Mesic* : *moist, neither extremely dry nor wet.

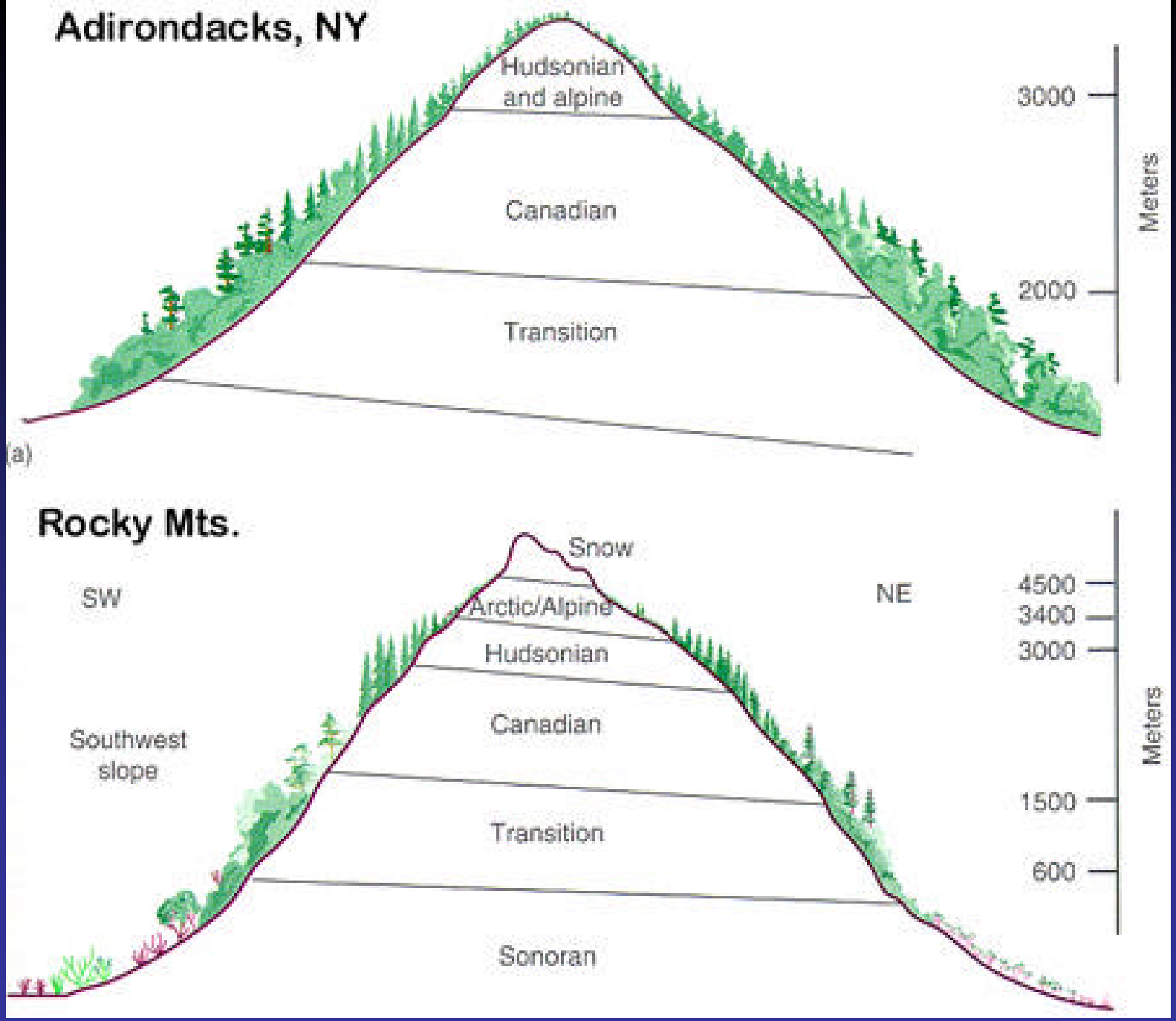
Hydric* : *extremely wet, often waterlogged or swampy.

Slope Position Variations in Microclimates



In Northern Hemisphere, N-facing slopes receive less solar insolation than do S-facing slopes, leading to cooler and moister conditions.

Ridges usually are drier than valleys due to more insolation plus more wind (both = more evaporation).


Adirondacks, NY
Hudsonian and alpine
Canadian
Transition
3000
2000
Meters
(a)
Rocky Mts.
SW
NE
Snow
Arctic/Alpine
Hudsonian
Canadian
Transition
Sonoran
Southwest slope
4500
3400
3000
1500
600
Meters